Contribution ID: **37** Type: **not specified**

Detection feasibility evaluation of ultra-intense magnetic field with dimuons at ALICE in Runs 2 and 3

Saturday 6 November 2021 16:00 (17 minutes)

High energy heavy ion collisions at the LHC generate extreme magnetic field reaching 10^{14} T~10^{15} T when heavy ions cross each other at almost the speed of light in peripheral collisions. The intensity of this generated magnetic field is much higher than the critical magnetic field of electrons, 4×10^{9} T, and various nonlinear behaviors such as real photon decay are expected in the linear regime of QED. In addition, there have been interesting discussions about synchrotron radiation and chiral magnetic effects in ultra-intense magnetic fields. However, its generation has not yet been detected experimentally.
Virtual photon polarization, one of nonlinear QED phenomena, will be measured with dimuons to detect the ultra-intense magnetic field. The effect of virtual photon polarization will manifest itself as anisotropy of dilepton decay plane. Prompt photons and the ultra-intense magnetic field exist at the same time, and Prompt photons are dominant in $|p_T| > 4$ GeV/c. The ALICE experiment has muon track system with high muon identification capability, so muon's signal-background ratio is higher than electrons. In Run 3 (2022-), higher muon's signal-background ratio is expected due to installation of a new detector, Muon Forward Tracker (MFT), that improves the accuracy of track detection. We plan to measure the virtual photon polarization using dimuons with $|p_T| > 4$ GeV/c.
It is essential to discuss the detection feasibility of virtual photon polarization via dimuon measurement. The virtual photon polarization due to the ultra-intense magnetic field is calculated by the vacuum polarization tensor including the one-loop level. It is found that the polarization in the measurement region ($|p_T| > 4$ GeV/c) appears at least 0.05. Moreover, we estimated the statistics of dimuons decayed prompt virtual photon and background in Runs 2 and 3 by simulation. In Run 2, the significance is found to be 0.57 σ in $|p_T| > 4$ GeV/c. It was also found that the significance is expected to increase to 1.8σ in Run 3 due to the 10-fold increase in the number of muons. Furthermore, the significance in Run 3 can be expected to be improved by the signal background removal by MFT, the dimuon mass cut and so on. Therefore, there is a possibility that a significant signal of virtual photon polarization can be detected in Run 3.

Author: KIMURA FOR THE ALICE COLLABORATION, Kento (Hiroshima University (JP))

Presenter: KIMURA FOR THE ALICE COLLABORATION, Kento (Hiroshima University (JP))

Session Classification: Contributed Session 2

Track Classification: Track group 2: Experiment